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Filed : May 14, 2001

REMARKS

Claims 17-43 are pending in the present application and stand rejected as anticipated by or obvious in view of several references. Each of the rejections is discussed below.

Claim Rejections Under 35 U.S.C. § 102

Claims 17-22, 24-25, and 32-35 stand rejected as anticipated by Sakuma et al. (U.S. Patent No. 5,270,247) or Yokoyama et al. (U.S. Patent No. 5,483,919). In the previous response, Applicant argued that Sakuma and Yokoyama fail to teach evacuation of an entire gas volume of the reaction chamber. In responding to Applicants' argument, the Examiner found that in view of the recitation of "a gas volume of the reaction space" in Claim 17, the claims should be interpreted to mean that an arbitrary volume of gas is evacuated from the reaction space, not that the entire volume is entirely evacuated. Applicants respectfully disagree and submit that in view of the specification, one skilled in the art would recognize that a gas volume of the reaction space is equivalent to a volume of gas corresponding to the entire gas volume of the reaction space. Nevertheless, solely to facilitate prosecution, Applicants have amended independent Claims 17 and 41 herein to recite evacuation of "a volume of gas corresponding to the gas volume of the reaction space." Dependent Claims 18-21, 34-35 and 42-43 have been correspondingly amended. Support for these amendments can be found, for example, at page 8, lines 5-10 and page 5, lines 14-16. These amendments do not add new matter and furthermore introduce no new issues, as the Examiner apparently understood Applicants intention but sought clarification for the record.

The Examiner also found that the "reaction space" is only the area immediately above the substrate and does not include the entire reaction chamber. Applicants disagree. At page 6, lines 21-28 of the specification, the term "reaction space" is explicitly defined to include both the space in which the substrate is located and in which the vapor phase reactants are allowed to react with the substrate in order to grow thin films, as well as the gas in-flow/out-flow channels communicating immediately with the reaction chamber. As a result, the reaction space includes not only the area immediately above the substrate, but the entire reaction chamber and the inflow and outflow channels as well.

In addition, the Examiner was not persuaded by Applicants' argument that the purge is not complete in the prior art references. The Examiner found that "The reference teaches that

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purging is efficient so that it is *more complete* in less time (column 5, lines 30-35)” and that reactants are “purged away (column 3, lines 45-55)” (emphasis in original). The Examiner concludes that in combination with a vacuum chamber, this reads on the entire chamber being evacuated.

Again, Applicants disagree. First, at column 5, lines 30-35, Sakuma et al. teaches that “the *separation* of the different source gases is made more complete in a shorter time” by utilizing a purge gas (emphasis added). It does not, as the Examiner implies, teach that the *purge* is made more complete. Sakuma et al. is simply pointing out that the use of a purge gas between the first and second reactants will physically separate the different source gases more effectively and in a shorter period of time than vacuum alone. Such physical separation by a purge gas does not, however, require or even suggest evacuating an entire gas volume corresponding to the gas volume of the reaction space.

Second, at column 3, lines 45-55 Sakuma et al. teaches “supplying a hydrogen gas over the crystalline substrate to purge away the V-group element source gas *for a predetermined time*” (emphasis added). Thus Sakuma et al. does not teach that the source gas is completely removed from the reaction chamber. Rather, this passage simply teaches that the purge gas is supplied for a certain amount of time. There is no teaching or suggestion to provide the purge gas for a period of time such that a gas volume corresponding to the gas volume of the reaction space is evacuated.

Finally, the Examiner indicates that it is not clear how a volume that is 3-10 times the volume of the entire chamber can be evacuated from the in embodiments in which the pressure is lowered. The skilled artisan will understand that this is possible in embodiments where an inert gas is provided to the reaction chamber while gas is simultaneously being removed from the chamber by a pump, i.e. the chamber inlet is not closed. As such embodiments are clearly disclosed in the specification, the removal of 3-10 times the volume of the reaction chamber is enabled.

Applicants respectfully submit that there is no teaching or suggestion in Sakuma et al. or in Yokoyama et al. to evacuate a volume of gas corresponding to the gas volume of the reaction space essentially totally in the interval between each successive vapor phase reactant pulse as recited in Claim 17. As a result, Applicants request withdrawal of the rejection of Claim 17. Claims 18-22, 24-25 and 32-35 depend from Claim 17 and have all the features thereof, in

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addition to further distinguishing features. Thus, the rejection of these dependent claims should be withdrawn as well.

Claim Rejections Under 35 U.S.C. §103(a)

Claims 26-31 were rejected as obvious over the combination of Sakuma et al. or Yokoyama et al. as applied to Claim 17, further in view of Moore (U.S. Patent No. 3,662,583).

As discussed above, neither Sakuma et al. nor Yokoyama et al. disclose evacuating a volume of gas corresponding to the gas volume of the reaction space between reactant pulses as recited in Claim 17. Moore does not cure this deficiency. Claims 26-31 each depend from Claim 17 and have all the features thereof. Thus, Applicants submit that this rejection should be withdrawn.

Claims 18-19, 23 and 33-45 were rejected as obvious in view of Sakuma et al. As discussed above, Sakuma et al. do not teach or suggest evacuating a volume of gas corresponding to the gas volume of the reaction space in an interval between successive reactant pulses as recited in Claim 17.

Applicants note that in rejecting Claims 18-19, 23 and 33-45, the Examiner found that "it is taught that purging should be long enough so that the *evacuation* is as complete as possible" (emphasis added), and concluded that it would have been within the skill of one in the art to modify the purging to meet the claims. As pointed out above, Sakuma et al. do not teach making the *evacuation* as complete as possible, but rather making the *separation* of reactants as complete as possible in the shortest time. Thus, they are not concerned with avoiding the coexistence of two reactant gases in the chamber at the same time, but rather with completely physically separating the two gases so that there is no intermixing of the reactants. This is similar to the "traveling wave" concept described by Suntola in U.S. Patent No. 4,389,973, in which 'boluses' or 'packets' of reactant gas are separated *in the reaction chamber* by a diffusion barrier of inert gas. As a result, there is no teaching in Sakuma et al. to keep the reaction space exposed to a single reactant at a time, and one of skill in the art would not be motivated to select conditions that would lead to evacuation of one or more gas volumes corresponding to the gas volume of the reaction space.

As Sakuma et al. has no disclosure that would motivate one of skill in the art to evacuate a volume of gas corresponding to the gas volume of the reaction space essentially entirely

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between reactant pulses, all of the limitations of Claim 17 are not taught or suggested. As Claims 18-19, 23 and 33-43 each depend from Claim 17 and contain all the features thereof, in addition to further distinguishing features, Applicants submit that they are not obvious in view of Sakuma et al.

With respect to Claims 41-43, Applicants again submit that Sakuma et al. fail to teach or suggest evacuating essentially totally a volume of gas corresponding to a gas volume of a reaction space in an interval between successive reaction pulses, as recited in amended Claim 41. As a result, the present rejection of Claim 41 should be withdrawn. Further, as Claims 42 and 43 depend from Claim 41, they contain all the features thereof, in addition to further distinguishing features. Accordingly, the rejections of these claims over Sakuma et al. should be withdrawn as well.

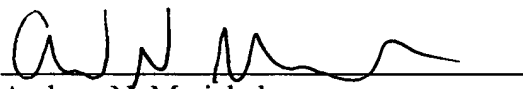
Conclusion

In view of the arguments presented above, Applicants submit that the present application is in condition for allowance. If any issues remain, the Examiner is invited to contact Applicants' representative at the number provided below in order to resolve such issues promptly.

Respectfully submitted,

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Dated: May 4, 2004

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